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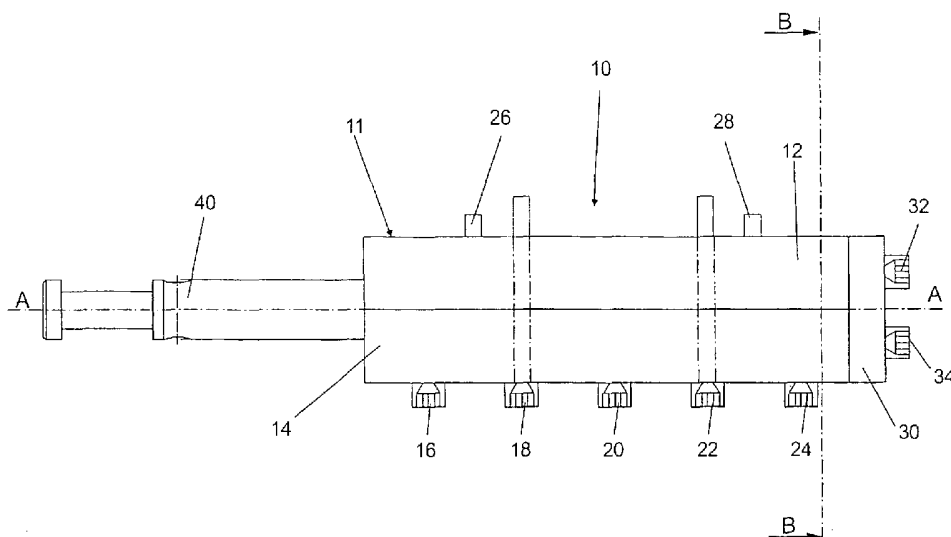
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(54) Title: **SLOT NOZZLE**



(57) **Abstract:** The invention relates to a slot nozzle for applying fluids, in particular hot-melt adhesives, onto a substrate, said nozzle having a nozzle body (11) through which a distribution channel (12) connectable to a fluid source extends in the axial direction of the nozzle body, and a slot (14) extending similarly in the axial direction, said slot having lateral edges (16, 18) to the direction of flow and two boundary surfaces spaced apart by the clearance width of the slot and connecting said edges, said slot leading from the distribution channel to an outlet (14) on the outside of the nozzle body, and with a flow limiter (26) provided on the nozzle body for limiting the thickness of the adhesive layer being produced, said flow limiter having a lower surface (28) beginning at the outlet of the slot and extending downstream to a cut-off edge (30). At least one opening (20) of predefined depth and extending from the outlet to the cut-off edge is incorporated into the lower surface and spaced apart from the lateral edges of the slot.

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### Slot nozzle

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The invention relates to a slot nozzle for applying fluids, in particular hot-melt adhesives, onto a substrate, having a nozzle body through which a distribution channel connectable to a fluid source extends in the axial direction of the nozzle body, and a slot extending similarly in the axial direction, said slot having lateral edges to the direction of flow and two boundary surfaces spaced apart by the clearance width of the slot and connecting said edges, said slot leading from the distribution channel to an outlet on the outside of the nozzle body, and with a flow limiter provided on the nozzle body for limiting the thickness of the adhesive layer being produced, said flow limiter having a lower surface beginning at the outlet of the slot and extending downstream to a cut-off edge.

Various fields of application in adhesives technology require that the adhesive be dispensed in the form of a thin, sharp-edged layer onto the part or parts to be bonded, so that the adhesive does not spreading beyond the edge of the plane adhesive layer when the parts being bonded are pressed together.

Different kinds of nozzles for applying areas of adhesive to surfaces are known. For example, German utility model 91 08 543.8 describes a elongated slot nozzle for dispensing fluids, in particular hot-melt adhesives, with which a coating of very uniform thickness is obtained. Such coatings usually have thicknesses between 0.2 mm and 0.4 mm, for example. The thickness depends to a substantial extent on the type of material being bonded.

One important application involves coating the edges of chipboards with hot-melt adhesive in order to attach edge bands. Chipboards adsorb part of the adhesive, which is why they typically require more adhesive and therefore a greater thickness of adhesive coating than plywood does, for example.

Experience has shown that the quality of adhesive bonding, for example of an edge band on a chipboard, can be improved still further. It has

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been found that part of the adhesive strength of the hot-melt adhesives normally used for such purposes is lost because, during the short time interval between dispensing the hot-melt adhesive and pressing together the parts being bonded, the temperature of the hot-melt adhesive falls by a certain amount, this fall in temperature being responsible for the loss of adhesive strength.

Against this background, the object of the invention was therefore to provide a way of slowing down the drop in temperature of the adhesive in order to enhance the quality of the adhesive bond between the parts.

With a slot nozzle of the kind initially specified, the object is achieved by at least one opening of predefined depth and extending from the outlet to the cut-off edge being incorporated into the lower surface and spaced apart from the lateral edges of the slot.

This causes a film of adhesive that is thinner at its edges and locally thicker to be applied to the substrate. Owing to this contouring, hot zones remain inside the adhesive even after the layer of adhesive close to the surface has cooled. When the edge band is subsequently pressed on, the hot adhesive is squeezed out from the central portion towards the sides. This leads to the adhesive in those areas as well having a higher mean temperature than previously. Since the adhesive effect increases with temperature, the quality of the adhesive bond is enhanced. Choosing sufficiently large edge portions, as well as the quantity and depth of the depressions and recesses, ensures that, despite the improvement in quality, the edges are still formed with high precision, due to the fact that the additional adhesive cannot reach the edges when the edge band is pressed on.

One advantage of the slot nozzle according to the invention is that the aforementioned increased in adhesive effect is achieved without complex additional designing.

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Uses for the nozzle according to the invention are not confined to hot-melt adhesives, but can also be advantageous for cold adhesives when the substrate has a surface that is not ideally smooth, or has local variance in absorbance. In such a case, for example when an edge band is being pressed on, the additional adhesive is primarily squeezed into those regions in which there is a lack of adhesive. The adhesive effect is improved in this case as well, and clean bonding at the edges is ensured.

Further details, features and advantages of the invention derive from the following description of two embodiments, in which reference is made to the enclosed drawings. These show:

- Fig. 1 a view of a nozzle according to the invention
- Fig. 2 a view of a sub-block of the nozzle along line A - A in Fig. 1,
- Fig. 3 a cross-section along line B - B in Fig. 1,
- Fig. 4 a cross-section along line B - B in Fig. 1 through a further preferred embodiment of the nozzle,
- Fig. 5 a detail drawing from Fig. 2 of the surface adjacent the slot
- Fig. 6 a view from below of the nozzle of the invention, and
- Fig. 7 a schematic diagram of the contour of the applied adhesive.

Fig. 1 shows a slot nozzle 10, with a nozzle body 11 comprised of two sub-blocks 12 and 14 that are tightly joined to each other with screws 16 - 24. Screws 18 and 22 project beyond sub-block 12 and serve to fasten the slot nozzle 10 to a holding device that is not included in the drawing. There are two pins 26 and 28 on sub-block 12 for precise and reproducible assembly of the slot nozzle.

On the right-hand side in Fig. 1, the slot nozzle 10 has a cap 30 that is screwed on to sub-blocks 12 and 14 with screws 32 - 38. Screws 36 and 38 cannot be seen in this view of the nozzle. On the side opposite the cap there is a piston 40.

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As Fig. 2 show, piston 40 can be pushed through an opening into a distribution channel 42. Distribution channel 42 is formed by two half-cylindrical bores in sub-blocks 12 and 14. A sealing element 44 is mounted onto the face of piston 40, which is inside slot nozzle 10 at all times. Hot-melt adhesive can flow via an adhesive inlet 46 into the distribution channel 42. Piston 40 determines the axial length of the distribution channel 42.

In the parting plane for sub-blocks 12, 14, a slot 48 runs from distribution channel 42 to the outside of the nozzle body 11, where it forms an outlet 45. In Fig. 1, said outlet 45 lies below the plane of the drawing and below line A – A, and at the lower defining edge of sub-block 12 shown in Fig. 2. The slot 48 has two lateral edges 47, 49. The edge 49 on the right in Fig. 2 is formed by cap 30. The left-hand edge 47 is defined by a metal vane 44 that is attached to the piston 40 and extends into the slot.

Sub-areas of the two sub-blocks 12, 14 run from one edge to the other and form the boundary surfaces 41, 43 of the slot 48. Depressions 50 – 70 are provided in these boundary surfaces. As shown by Fig. 3, slot 48 extends as far as the distribution channel 42. Depressions 50 – 70 begin at the outlet 45 and end, in the embodiment shown in Fig. 3, before distribution channel 42. Because depressions 50 – 70 end before distribution channel 42, the portion of slot 48 between the distribution channel 42 and the beginning of the depressions forms a throttle for the hot-melt adhesive flowing out of distribution channel 42 into slot 48.

According to Fig. 3, the hot-melt adhesive exiting from outlet 45 comes into contact with a substrate 72, where it forms an adhesive coating. Substrate 72 moves relative to slot nozzle 10 in the direction shown by an arrow; this movement results in a plane film of adhesive 110.

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Fig. 4 shows another preferred embodiment of the invention, in which depressions 50 – 70 extend over the entire height of slot 48 and thus begin at outlet 45 of slot nozzle 10 and end in distribution channel 42.

In both the embodiment shown in Fig. 3 and the embodiment shown in Fig. 4, slot nozzle 10 has a flow limiter 75 at the end of slot 48 on the side facing the substrate, said flow limiter having a lower surface 74 on the side facing the substrate. The hot-melt adhesive flowing out of slot 48 passes between the flow limiter 75 and the substrate 72, and breaks contact with the slot nozzle 10 at a cut-off edge 73. Said cut-off edge 73 preferably forms a sharp angle with the lower surface 74 of the flow limiter 75, causing the hot-melt adhesive to break off cleanly from the slot nozzle and not collect in lumps of cooling hot-melt adhesive.

The thickness of the des hot-melt adhesive depends on the gap  $x$  between the slot nozzle 10 and the substrate, the speed of the substrate relative to the slot nozzle 10, the temperature-dependent viscosity and the pressure of the hot-melt adhesive. The thickness of the film can be controlled by adjusting one or more of these parameters.

As Fig. 5 in combination with Fig. 3 or 4 shows, the flow limiter 75 has recesses 76 – 96 of semi-circular cross-section at regular spacings on its lower surface 74. Recesses 76 – 96 extend in the direction of flow (arrow P in Fig. 3 or 4) from those points at the boundary walls of slot 48 where depressions 50 - 70 are located to the cut-off edge 73 at the downstream end of flow limiter 75. Transversely to the direction of flow, the respective outer recess 78, 96 (Fig. 5) through which the hot-melt adhesive flows is spaced at a predefined distance from the lateral edges of the adhesive film.

In this way, channel-like indentations are formed, as shown in a view from below in Fig. 6. The hot-melt adhesive flows into slot nozzle 10 through the adhesive inlet 46 (Fig. 2) and from there through slot 48 in

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the direction of the flow limiter 75. The cross-section of slot 48 is widened at depressions 50 – 70 so that the flow of adhesive is greater in these regions. This additional hot-melt adhesive flows through recesses 76 – 96 in the lower surface 74 of flow limiter 75 and in this way forms elevations 98 – 108 (Fig. 7) on the adhesive film 110, with the result that a contoured adhesive film is obtained.

The height of the film from the lower side to the peaks is approx. 0.5 mm to 1 millimeter, for example, whereby the elevations account for about half of the overall height.

This adhesive film is applied, for example, to the edge of a chipboard. After leaving the nozzle, the hot-melt adhesive begins to cool. Seen in cross-section, the lines of equal temperature always run substantially at the same spacing from the surface. Temperature nests that cool significantly more slowly than those areas at the immediate surface are therefore formed inside the elevations. If the edge band is then placed on the film and pressed against it, the hot-melt adhesive is spread from the temperature nests over a larger area and produces its greater adhesive effect.

This effect can be reinforced by selecting a lower height for the adhesive film between two elevations, for example between 98 and 100, or 100 and 102,..., than at the edges. In such a case, the adhesive effect at the edge is assured, albeit of lesser strength, whereas the effect described above, namely that more hot-melt adhesive is available when joining two parts, is achieved between the elevations.

In another embodiment not shown in the drawings, only one depression and/or one recess of rectangular cross-section is provided that is narrower transversely to the direction of flow than the slot.

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### Claims

1. Slot nozzle for applying fluids, in particular hot-melt adhesives, onto a substrate, having a nozzle body (11) through which a distribution channel (42) connectable to a fluid source extends in the axial direction of the nozzle body, and a slot (48) extending similarly in the axial direction, said slot having lateral edges (47, 49) to the direction of flow and two boundary surfaces spaced apart by the clearance width of the slot (48) and connecting said edges, said slot leading from the distribution channel (42) to an outlet (45) on the outside of the nozzle body, and with a flow limiter (75) provided on the nozzle body for limiting the thickness of the adhesive layer being produced, said flow limiter having a lower surface (74) beginning at the outlet (45) of the slot and extending downstream to a cut-off edge (73), characterized in that at least one opening (76) of predefined depth and extending from the outlet (45) to the cut-off edge (73) is incorporated into the lower surface (74) and spaced apart from the lateral edges of the slot (76).
2. Slot according to claim 1, characterized in that at least one depression is incorporated in the walls of the slot (48) forming the boundary surfaces, said depression being spaced apart from the lateral edges and running from the outlet (45) in the direction of the distribution channel.
3. Slot nozzle according to one of the preceding claims, characterized in that a plurality of depressions are provided and distributed on both of the boundary surfaces defining the slot.



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4. Slot nozzle according to one of the preceding claims, wherein a plurality of openings are provided and are incorporated approximately parallel to each other in the lower surface of the flow limiter.
5. Slot nozzle according to one of the preceding claims, characterized in that all depressions and openings have a constant depth along their length.
6. Slot nozzle according to claim 5, wherein the depressions in the boundary surfaces are provided in pairs, one opposite the other.
7. Slot nozzle according to one of the preceding claims, characterized in that each depression runs from the outlet (45) as far as the distribution channel.
8. Slot nozzle according to one of the preceding claims, wherein each depression is contiguous on the outlet side with an associated opening in the flow limiter.
9. Slot nozzle according to one of the preceding claims, characterized in that the openings (76) have a curved cross-section.
10. Slot nozzle according to one of the preceding claims, characterized in that at least three openings (76, 78, 80) are present and that said openings are arranged with equal spacing from each other.
11. Slot nozzle according to one of the preceding claims, characterized in that the cut-off edge forms a pointed angle with the lower surface of the flow limiter.

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12. Slot nozzle according to one of the preceding claims,  
characterized in that the flow limiter can be heated.

Fig. 1

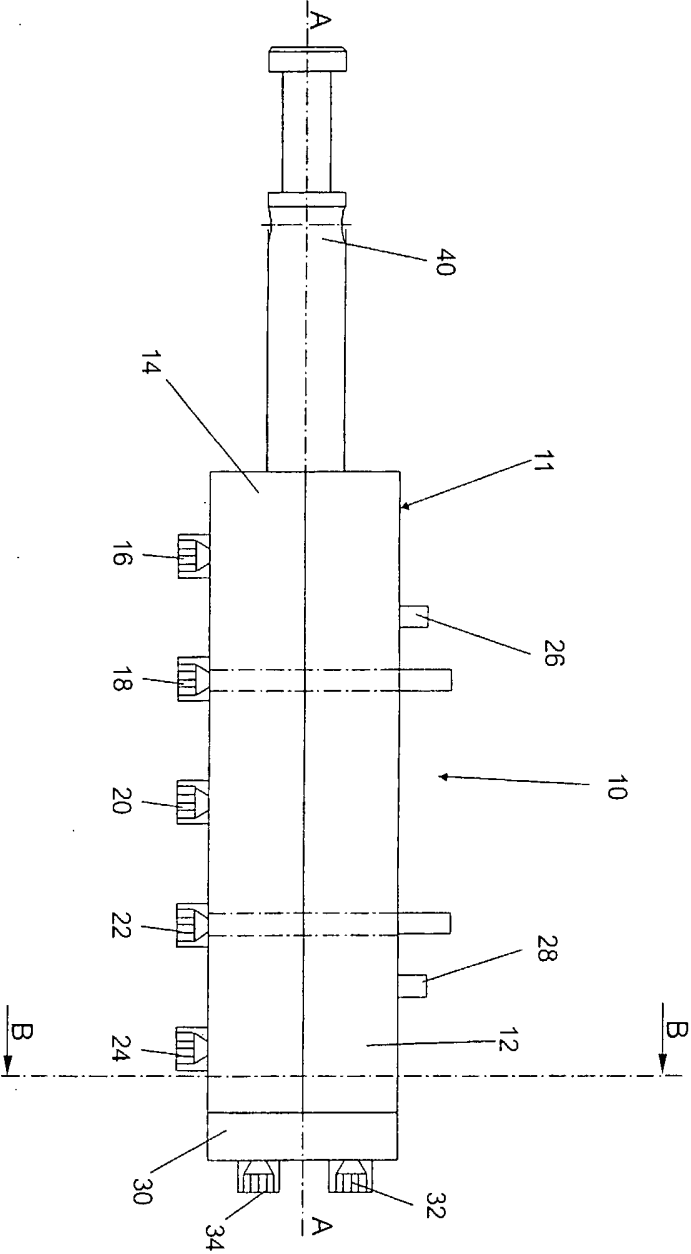


Fig. 2

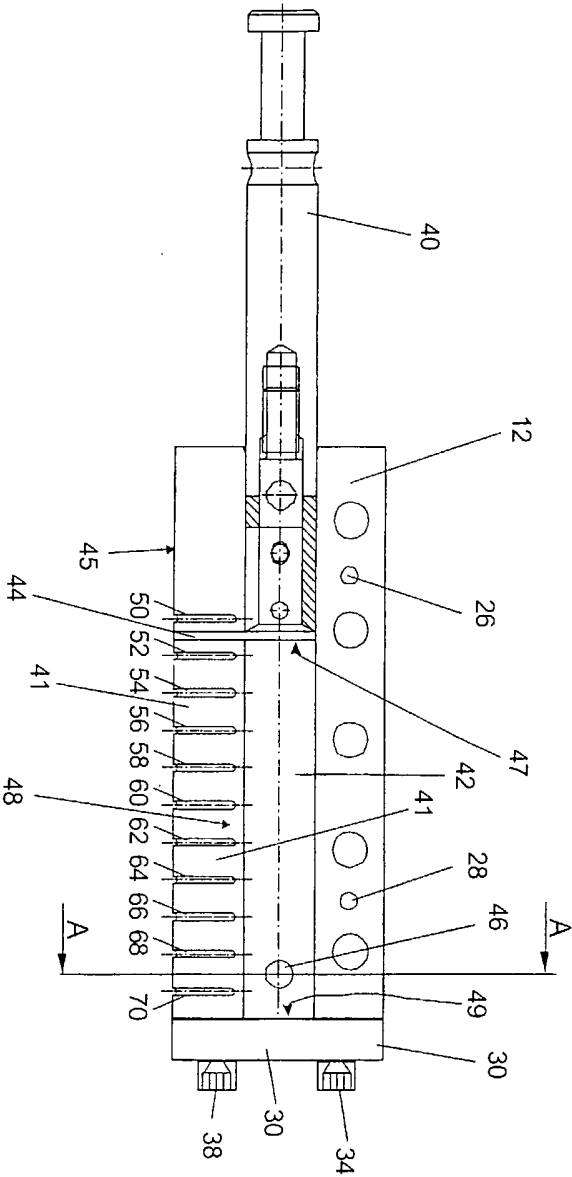


Fig. 3

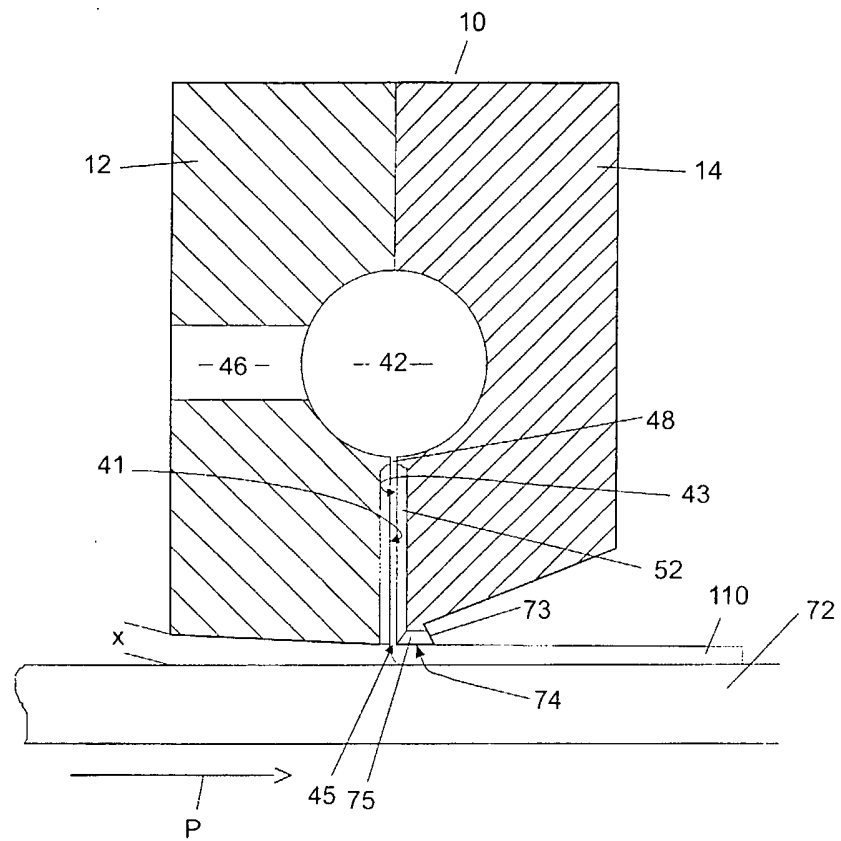


Fig. 4

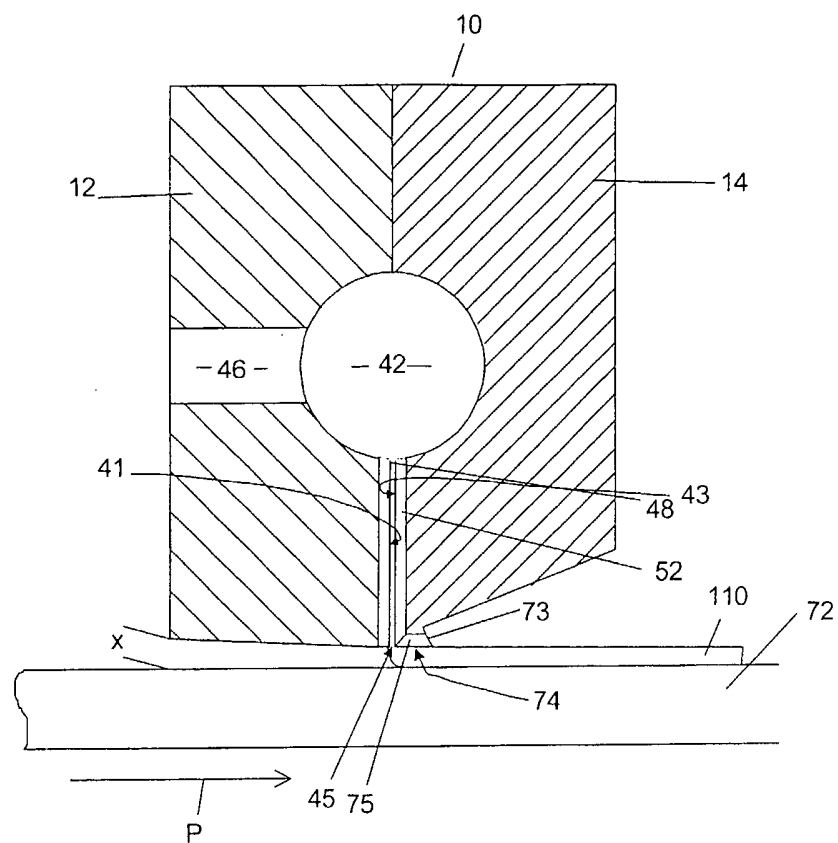
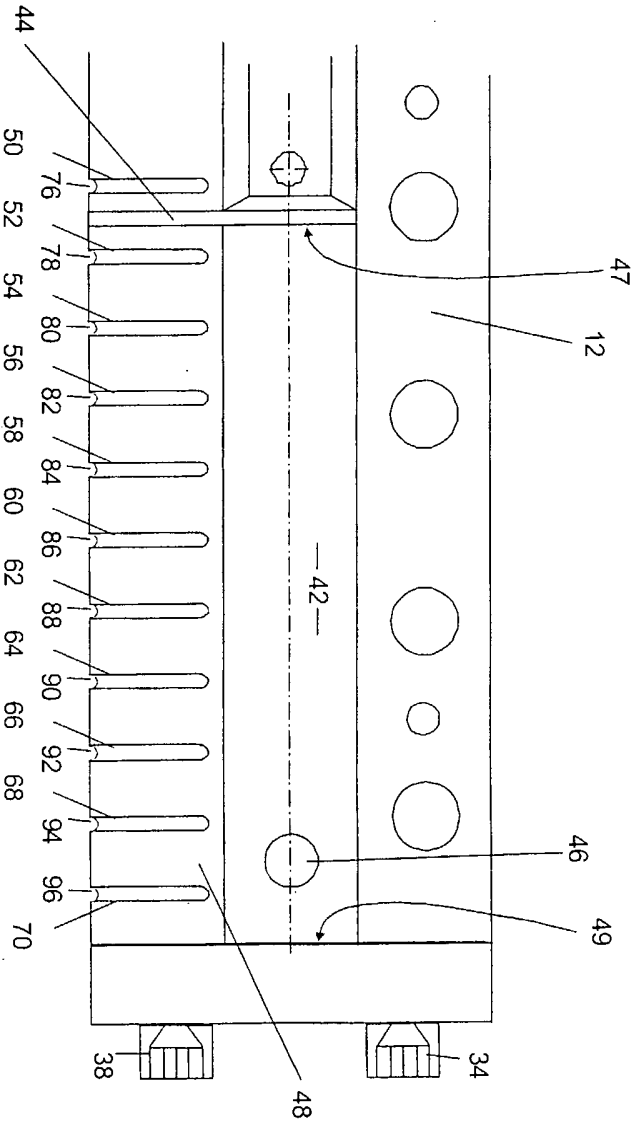


Fig. 5



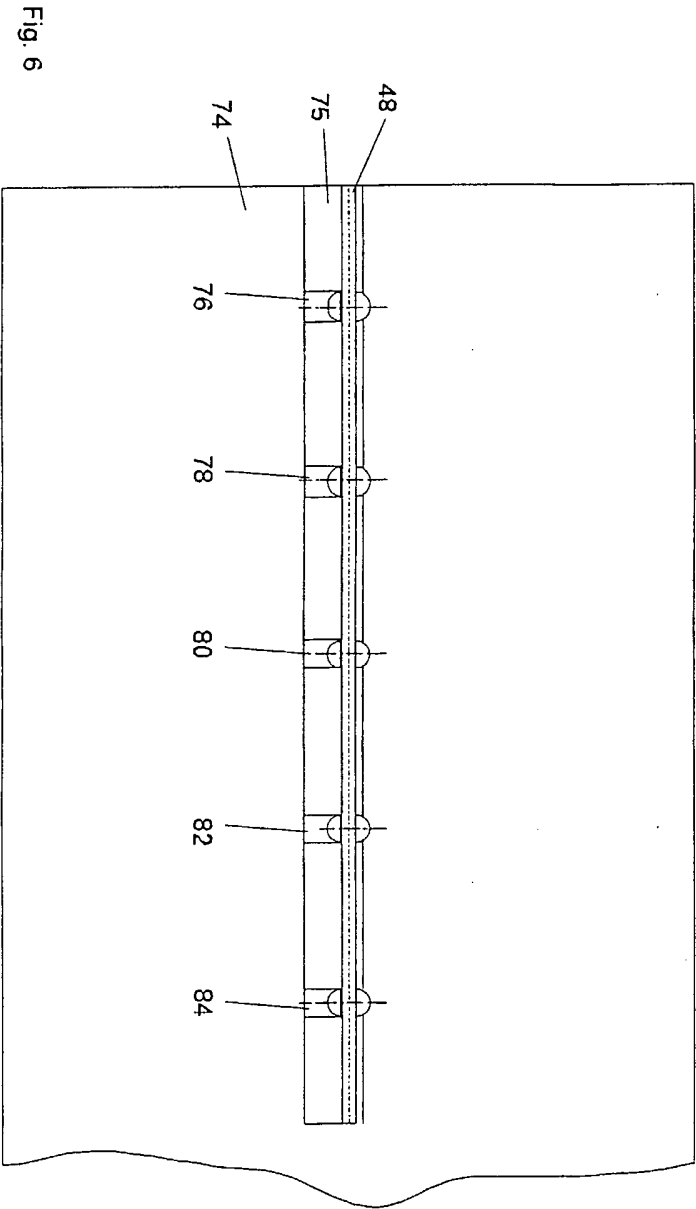
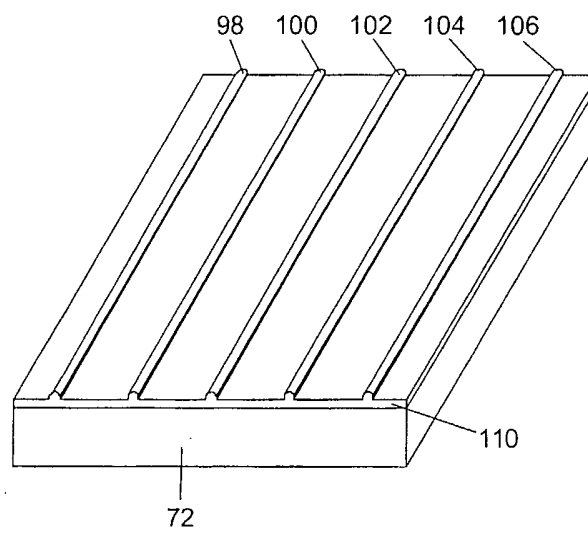




Fig. 7



## INTERNATIONAL SEARCH REPORT

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B05C5/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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